Department of Energy
Idaho Field Office
850 Energy Drive
Idaho Falls, Idaho 83401-1563

October 23, 1995

Howard Orlean
Federal Facility Section
U.S. Environmental Protection Agency
Region 10
1200 Sixth Avenue
Seattle, Washington 98101

Scott Reno
Idaho Department of Health & Welfare
900 N. Skyline
Idaho Falls, ID 83402

SUBJECT: Disposal of Drill Cuttings from Monitoring Well (MW)-18

Dear Howard and Scott:

During the drilling and construction of Monitoring Well (MW)-18, drill cuttings that were produced during the drilling operations were containerized into three poly tanks. These drill cuttings were containerized due to the possibility of radionuclide contaminated dust being produced. In constructing this monitoring well, hollow stem auguring was used from the surface of the alluvial sediments to the top of the basalt. Next, air rotary drill was used to drill the monitoring well through the basalt layers and sedimentary interbeds into the Snake River Plain Aquifer (SRPA).

The drill cuttings contained in these poly tanks have been sampled. Samples from sampled drill cuttings were analyzed for gross α, gross β, and γ emitting radionuclides. These result are presented in the attached data summary (Attachment 1). Only the gross β analysis for three samples were positive.

A screening level risk evaluation for all pathways was conducted on these sediments to determine if the sediments would present a risk. The approach and calculations are contained in Attachment 2. All of the pathways would not present an unacceptable risk ($<10^{-6}$).

Based on the above information and the information contained in the attachments, I am recommending that the soil be allowed to be disposed of on the ground in the vicinity of MW-18. In addition, the drill cuttings will be covered with gravel at the site to minimize the dust which could be potentially blown around. If you have any questions, please call me at (208) 526-4978.

Sincerely,

Talley Jenkins

Talley Jenkins, WAG 3 Manager
Environmental Restoration Program

Attachments

FINAL REPORT for MV18POLYTANK

Log Type: ** PLANT **

Report for : B WILLS
Mailstop : 5117

Log Number : 95-090510
Phone Number : 6-5217

Date Received : Sep 05 1995
Time Received : 16:34

Date completed : Oct 10 1995
Time completed : 10:38

GWA charged : T41130113

Reviewed by BEN HUNTER

MSA mR/hr : <.1

Signature Ben Hunter

Hazard Index : <1e4

Lab QC/QA reviewed by

Quality Level : III

Signature M

Analysis	Sample	Method	Analyst	Results
ALPHA	MW18PT1A	13450	KLJ	-2.10339E+00 pCi/g
	MW18PT1B	13450	KLJ	-4.82891E-02 pCi/g
	MW18PT2A	13450	KLJ	-1.51078E+00 pCi/g
	MW18PT2B	13450	KLJ	-1.0423E+00 pCi/g
	MW18PT3A	13450	KLJ	-4.[illegible]38E-01 pCi/g
	MW18PT3B	13450	KLJ	-4.55033E-01 pCi/g
BETA	MW18PT1A	13450	KLJ	-9.33228E+00 pCi/g
	MW18PT1B	13450	KLJ	-4.32903E-01 pCi/g
	MW18PT2A	13450	KLJ	1.79438E+00 pCi/g
	MW18PT2B	13450	KLJ	1.81705E+00 pCi/g
	MW18PT3A	13450	KLJ	1.31322E+00 pCi/g
	MW18PT3B	13450	KLJ	-7.21751E+00 pCi/g
GAMMA SCAN	MW18PT1A	63993	LRH	No Nuclides Identified
	MW18PT1B	63993	LRH	No Nuclides Identified
	MW18PT2A	63993	LRH	No Nuclides Identified
	MW18PT2B	63993	LRH	No Nuclides Identified
	MW18PT3A	63993	LRH	No Nuclides Identified
	MW18PT3B	63993	LRH	No Nuclides Identified

End of Report -- 18 results.

— less than background

$\boxed{\text{Talley}}$ FAX 6-0160

Dust/cutting from MW-18 which was collected in 3 poly tanks: 2 foam (#1 + #3) and 1 soil (#2)
2 samples from each tank: Each sample is composite from entire depth/height of matrix.

Screening Level Calculations for the disposal of containerized drill cutting from Monitoring Well (MW)-18 in the vicinity of MW-18

The amount of drill cutting in the three poly tanks has been estimated based on a visual examination of the three poly tanks stationed near MW-18 at the ICPP. The volume of material contained in poly tanks #1 and #3 have been combined into one volume (77 ft^3) as shown below. A foaming agent that was used during the drilling of MW-18 for dust suppression due to the possibility of radionuclides being contained in the drill cuttings. Also, the foaming agent was used to help float (bring to the surface) the drill cuttings out of the borehole during the deeper stages of the drilling on MW-18. Drill cuttings contained in poly tank #2 were produced during the drilling of basalt and the redrilling of the borehole following grouting of the borehole to fill fractures and other problems encountered during drilling. The estimated volume of material contained in poly tank #2 is 212 ft^3 as determined by visual inspection of the poly tank. Between 1/2 and 2/3 of the drill cutting contained in poly tank #2 are grout cuttings produced during the redrill operations conducted during drill of MW-18.

As the material contained in the poly tanks consists mainly of basalt cuttings along with grout cuttings and some sedimentary interbed material, the density of basalt (1.9 g/cm^3) is used for the calculations as shown below. In addition, the densities used for the alluvial sediments, basalt, and sedimentary interbeds (shown below) are the Track 2 default values.

The value shown below for the porosity of the cuttings was obtained from the information collected on the ICPP Tank Farm sediments as part of the ICPP Tank Farm Investigation.

Volume of foam (cuttings) in poly tanks #1 and #3	77 ft^3	2.18e+06 cm^3	
Volume of soil (cuttings) in poly tank #2	212 ft^3	6.00e+06 cm^3	
Volume of source (cuttings)	289 ft^3	8.18e+06 cm^3	
Density of source sediments	1.9 g/cm^3		
Mass of source volume	1.6e+07 g		
Porosity of source sediments	0.29 cm^3/cm^3		
Density of alluvial sediments	1.5 g/cm^3		
Density of basalt	1.9 g/cm^3		
Density of interbed sediments	1.5 g/cm^3		
Alluvial infiltration rate	3.28 ft/yr	1.00e+02 cm/yr	1.00 m/yr
Basalt infiltration rate	38.1 ft/yr	1.16e+03 cm/yr	11.6 m/yr
Interbed infiltration rate	38.1 ft/yr	1.16e+03 cm/yr	11.6 m/yr
Alluvial sediments moisture content	0.42 m^3/m^3 (unsaturated)		
Basalt moisture content	0.12 m^3/m^3 (unsaturated)		
Interbed sediments moisture content	0.58 m^3/m^3 (saturated)		

For the screening calculations, the alluvial infiltration rate (as shown above) is based on default Track 1 value of 1 m/yr and the basalt and interbed infiltration rates of 11.6 m/yr are based on amount of water necessary to maintain the observed 110 ft perched water zone. The moisture content values used (as shown above) are based on the infiltration rates and the Van Genuchten curves for the different materials.

Based on the infiltration rate for the alluvial sediments and the Van Genuchten curve for the alluvial sediments, unsaturated conditions exist for the alluvial sediments. As the hydraulic conductivity for the basalt material is very large, the infiltration rate used results in unsaturated conditions for the basalt. The infiltration rate used for the sedimentary interbed material results in a saturated condition.

In order to screen these drill cuttings for disposal, a simplified stratigraphy of the site has been developed. This simplified stratigraphy based on "simplified model (poreflow)" that was developed for the WAG 3 Comprehensive RI/FS and is contained in the WAG 3 Comprehensive RI/FS Work Plan, Attachment 4, Figure 5. As can be seen below, the stratigraphy below the ICPP has been simplified into a 6 layer model.

As the drill cuttings would be disposed of at the surface, the entire thickness the alluvial sediments is shown in the table below and will be used in subsequent calculations. For the upper sedimentary interbed sediments, the composite thickness of interbed materials (18.3 ft) from 0 ft to 145 ft is shown below and is used in subsequent calculations. Also for the lower interbed, the composite thickness of sedimentary interbeds (45.9 ft) from 145 ft to 425 ft is shown below and is used in subsequent calculations.

Thickness of sediments under source	30 ft	9.14e+02 cm	9.1 m
Thickness of basalt above upper interbed	80 ft	2.44e+03 cm	24.4 m
Thickness of upper interbed	18.3 ft	5.58e+02 cm	5.6 m
Thickness of basalt between interbeds	251.7 ft	7.67e+03 cm	76.7 m
Thickness of lower interbed	45.9 ft	1.40e+03 cm	14.0 m
Thickness of basalt below lower interbed	39.1 ft	1.19e+03 cm	11.9 m

Two samples (composites over entire depth of containerized cuttings) were collected from each of the poly tanks and analyzed for gross α, gross β, and γ spectroscopic radionuclides. The results are shown in the attached data summary. From these results, it can be seen that the only positive results obtained were for gross β radionuclides for one sample in poly tank #3 and for both samples in poly tank #2. As the level of gross β radionuclides detected in the samples (less than 2.00 pCi/g) is less than the gross β value for background at the surface (30 pCi/g) and the materials are basically basalt and grout drill cuttings, screening against background may not be appropriate. Because strontium (Sr)-90 has been detected in the perched water in this area as the major contaminant, it is assumed that the gross β detected is Sr-90.

Contaminant of concern	Sr-90
Contaminant concentration (pCi/g)	2.00
Half-life (yrs)	28.1
Decay constant (yr^{-1})	2.47e-02
Alluvial sediments distribution coefficient (K_d: mL/g)	24
Basalt distribution coefficient (K_d: mL/g)	24
Interbed sediments distribution coefficient (K_d: mL/g)	24
Groundwater ingestion slope factor (pCi^{-1})	5.59e-11
Soil ingestion slope factor (pCi^{-1})	5.59e-11
Inhalation of fugitive dust slope factor (pCi^{-1})	6.93e-11
External exposure slope factor (pCi^{-1})	0.00e+00

It is a conservative assumption to assume that the gross β detected is Sr-90 as the actual concentration of Sr-90 would be approximately 1/2 of this values. This is due to Sr-90 being in equilibrium with Y-90 (its daughter product). In addition, the actual maximum detected concentration for the gross β radionuclides is 1.82 pCi/g as shown in the attached data summary.

The values for the slope factors and half-life shown above were obtained from the Health Effects Assessment Summary Tables FY-1994 Supplement No. 2 and are for Sr-90 with daughter product. In addition to the slope factor for groundwater ingestion, slope factors for soil ingestion, inhalation of fugitive dust, and external exposure are included. Risk calculations for all pathways have been calculated and are presented below.

The distribution coefficients (K_d values) for the alluvial sedimentary, basalt, and sedimentary interbeds materials shown above are the default Track 2 values contained in Table F-1 of the Track 2 Guidance Document.

The pore water velocity is calculated based on equation 3 in the WAG 3 Comprehensive RI/FS Work Plan, Attachment 4 as shown below, where r is the infiltration rate (shown above) in cm/yr and θ is the volumetric moisture content (shown above) in cm^3/cm^3.

$$v_{pw} - \frac{r}{\theta}$$

As it is assumed for screening purposes that the porewater can instantaneously travel through the basalt, no pore velocity is calculated for the basalt.

The retardation factors are calculated based on equation 5 in the WAG 3 Comprehensive RI/FS Work Plan, Attachment 4 as shown below, where K_d is the distribution coefficient (shown above), ρ_s is the density of retarding material (shown above), and θ is defined above.

$$R_f = \frac{K_d \, \rho_s}{\theta}$$

The activity was calculated by multiplying the concentration (pCi/g) by the mass of contaminated sediments and the source concentration (pCi/cm^3) was calculated by multiplying the concentration (pCi/g) by the volume of contaminated sediments.

The porewater leachant concentration (pCi/L) is calculated based on equation 1 in the WAG 3 Comprehensive RI/FS Work Plan, Attachment 4 as shown below, where C is the concentration (pCi/cm^3) calculated above and the other term as defined above.

$$C_l = \frac{1000 \; C}{(\theta + K_d \, \rho_s)}$$

The risk from ingestion of the porewater leachant is calculated based on the equation shown below, where C_{pw} is the porewater leachant concentration, IR is ingestion rate (2 L/day), EF is exposure frequency (350 days/yr), ED is exposure duration (30 years), and SF is the groundwater ingestion slope factor (pCi^{-1}).

$$Risk = C_{pw} * IR * EF * ED * SF$$

The travel times for movement of the porewater leachant through the alluvial sediments and sedimentary interbed materials is calculated based on the equation 4 in the WAG 3 Comprehensive RI/FS Work Plan, Attachment 4 as shown below, where D_s is the thickness of the retarding material, v_{pw} is the porewater velocity calculated above, and R_f is the retardation factor calculated above.

$$T_s = \frac{D_s}{(v_{pw} / R_f)}$$

The concentration of the contaminant after traveling through a retarding material is calculated based on the equation 6 in the WAG 3 Comprehensive RI/FS Work Plan, Attachment 4 as shown below, where C_{pw} is the porewater leachant concentration calculated above, T_s is the travel time through the retarding materials above the calculation location, and λ is the decay constant as shown above.

$$C = C_{pw} * e^{-(T_s * \lambda)}$$

unsaturated pore velocity (alluvial sediments)	2.38e+02 cm/yr
unsaturated pore velocity (interbed sediments)	2.00e+03 cm/yr
Contaminant	Sr-90
Retardation factor (alluvial sediments)	87
Retardation factor (interbed sediments)	63
Source activity (pCi)	3.11e+07
Source concentration (pCi/cm^3)	3.80e+00
Porewater leachant concentration (pCi/L)	8.26e+01
Risk from ingestion of porewater leachant at source of contamination	9.69e-05
Porewater leachant travel time to top of basalt (yrs)	3.33e+02
Porewater leachant concentration at top of basalt (pCi/L)	2.23e-02
Risk from ingestion of porewater leachant at top of basalt	2.62e-08
Porewater leachant travel time to bottom of upper interbed (yrs)	3.51e+02
Porewater leachant concentration at bottom of upper interbed (pCi/L)	1.45e-02
Risk from ingestion of porewater leachant at bottom of upper interbed	1.70e-08
Porewater leachant travel time to bottom of lower interbed (yrs)	3.95e+02
Porewater leachant concentration at bottom of lower interbed (pCi/L)	4.88e-03
Risk from ingestion of porewater leachant at bottom of lower interbed	5.72e-09
Risk from ingestion of soil	1.45e-07
Risk from inhalation of fugitive dust	3.68e-12
Risk from external exposure	0.00e+00

As can be seen above the porewater leachant concentration at the source would present an unacceptable risk, but by the time the porewater leachant has reached the top of basalt the concentration is within the acceptable risk range ($<10^{-6}$). In addition, the actual concentrations would be significantly less than the predicted concentration using this screening approach. The porewater would be diluted by the infiltrating moisture (water) and the travel time for the contaminants to move through the basalt layers.

The risks calculated for the ingestion of soil, inhalation of fugitive dust, and external exposure is calculated based in the equations contained in the Track 2 guidance document and slope factors shown above. In order to calculate the inhalation of fugitive dust, the particle emission factor (PEF: m^3/kg) was calculated by assuming a source area of contamination of 24 ft by 24 ft by 6 inches deep.

Based on the above risk values, the risk posed by disposing of these sediments near MW-18 would be within the acceptable risk range ($<10^{-6}$).